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CONNECTOR FOR DIALYSIS MACHINE PORT

This invention relates to a connector for connecting a dialysate port of a hemodialysis machine to a dialysate-carrying line according to the preamble of Claim 1.

During a hemodialysis treatment, blood is taken from a patient with the help of an extracorporeal circulation and is passed through a hemodialysis machine. Such dialysis machines today consist of a bundle of thousands of semipermeable hollow fiber membranes through the interior of which the blood is passed. A cleaning fluid - the dialysis fluid or the dialysate - is circulated on the outside of the hollow fibers so that the substances to be removed from the blood enter this fluid by diffusion and/or convection.

Such a hemodialysis machine generally has four liquid connections, which are known as ports: two for blood and two for the dialysate. The tubing system of the extracorporeal blood circulation and the dialysate-carrying line system in the sense of one incoming line and one outgoing line is connected to these ports. For the purpose of uniformity in use, standardized port forms are used for the blood ports on the one hand and for the dialysate ports on the other hand. Although the connecting system for the blood tubing system is designed to work with disposable items, the tubing used for the lines carrying the dialysate with many hemodialysis machines for treatment of chronic renal insufficiency is reusable. The Hansen coupling, as it is called, is used as the connecting system. With the Hansen coupling, the connection to the dialysate port is locked by a metallic ball bearing element. According to DIN 58352, the dialysate port consists of an essentially tubular projection having a peripheral

undercut upstream from the end of the port in the sense of a reduced outside diameter in which the balls of the ball bearing element engage. Between individual treatments, the dialysate-carrying lines are rinsed and cleaned together with the remaining dialysate circulation.

However, with other hemodialysis machines, disposable tube sets are also used for the dialysate-carrying lines. In this case it is expedient to use a design different from the Hansen coupling for the corresponding connector, in particular when the connector is also a disposable part.

EP 0 442 310 A1 describes dialysis machine ports of a hemodialysis machine which allow connection of Hansen couplings as well as other connectors. To this end, the dialysis machine port is provided with a thread onto which a corresponding connector mating piece can be screwed.

A screwing motion to establish the connection is a disadvantage inasmuch as it is difficult to determine the endpoint of the screwing motion. Leakage may occur if the connector is not screwed on adequately, while on the other hand, if too much force is applied to the end of the connector, it may quickly result in damage to the sealing elements, which are generally provided in these connectors. In addition, this connector may be used only when the ports on the dialysis machines are also designed accordingly, i.e., design measures are also required on the mating piece of the connector.

The object of this invention is to improve upon a generic connector, so that it can be manufactured suitably as a disposable item while at the same time permitting simple and reliable connection of a

dialysate-carrying line to a dialysate port of a hemodialysis machine without requiring structural measures on the dialysis machine itself.

According to the teaching of this invention, this object is achieved by a connector having the features of Claim 1. Design embodiments of this invention are the object of the subclaims.

This invention is based on the observation that the dialysate port designed according to DIN 58352 has a peripheral undercut on the outside. This undercut can be used for a shift element that is provided on the connector designed according to this invention for locking the connector. In this case it is not necessary to redesign the port on the dialysis machine end.

Additional details and advantages of this invention are described in greater detail below on the basis of an exemplary embodiment as depicted in the drawings, which show:

Fig. 1 - a side view of an embodiment of the inventive connector with the shift element in the first position,
Fig. 2a - a view of section A-A in Fig. 1,
Fig. 2b - a view corresponding to that in Fig. 2a, showing the shift element in the second position,
Fig. 3a - a section through the connector from Fig. 1 along the axis of symmetry and as seen in the direction of shifting of the shift element, whereby the shift element is in the first position, and
Fig. 3b - shows a view corresponding to that in Fig. 3a, showing the shift element in the second position.

Fig. 1 shows an embodiment of the inventive connector 1 for connecting a dialysate port of a hemodialysis machine to a dialysate-carrying line (not shown) in a

side view. The connector 1 consists of a base body 2 and a shift element 3. The base body 2 is composed of a first cylindrical sleeve 4, which is situated on the first end of the connector 1 that is to be connected to the dialysis machine port, and a second cylindrical sleeve 5, which is situated on the second end of the connector 1 that is to be connected to the dialysate-carrying line. The outside diameter of the first sleeve is greater than the outside diameter of the second sleeve, which is determined by the dimensions of the lines to be connected. The two sleeves have a fluid-tight connection in a connecting area 7, as shown in Figs. 3a and 3b. A lumen (not shown in Fig. 1) extends through the base body of the connector, and in the case of the connection, some of the dialysate flows through this lumen, and for the remainder, it accommodates the dialysate port of the dialysis machine.

A recess 6 is provided on the side facing the view in Fig. 1, and a recess 6' is provided on the opposite side (not shown) to accommodate the shift element 3 in the first end 4 of the connector 1. The shift element 3 is shown in the first position in Fig. 1. It can be moved into the second position in the direction of the arrow.

Fig. 2a shows a sectional view A-A from the view in Fig. 1. The shift element 3 is in the first position accordingly. This shows the lumen 8 of the first cylindrical sleeve 4 and the recesses 6 and 6' in which the shift element 3 can be moved from the first position into the second position.

The shift element 3 also has an overall keyhole-shaped opening composed of a first round opening 9 and a second elongated opening 10 connected to the former in the shift direction. In the first position of the shift

element 3 shown in Fig. 2a, the first opening 9 is arranged concentrically with the lumen 8 of the first end 4 of the connector 1 so that the lumen 8 is not constricted. The first opening 9 is widened slightly in an area 11 opposite the second opening 10, so that projections 12 and 12' that point inward are formed at the border with the expanded opening 11. Recesses that are complementary to these projections are formed in the recesses 6 and 6', so that the projections 12 and 12' can engage in them. These recesses are also provided symmetrically on the opposite side of the first sleeve 4 where they are labeled as 13 and 13'. This had the advantage that the base body 2 has mirror symmetry with respect to the plane perpendicular to the shift direction, which makes complex orientation of the base body 2 in assembly with the shift element 3 superfluous.

Due to the engagement of the projections 12 and 12', the connector 1 can be supplied with the shift element 3 in the first position without the user having to convince himself by actuation of the shift element 3 that the first opening 9 is aligned with the lumen 8 when the connector is used. The bracket 21 on the shift element 3 then comes to a stop on the base body 2 on the outside of the base body.

An enlarged opening area 14 and 14' is provided in the second opening 10, running concentric with the lumen 8 when the shift element is in the second position (Fig. 2b). In this position the second opening 10 constricts the lumen 8 in the direction of the recesses 6 and 6'. The contours of the opening areas 14 and 14' conform to those of the dialysate port of the hemodialysis machine. Due to the slightly restricted width of the opening 10 directly next to the regions 14 and 14', the shift element 3 is also held in the second position -

with the dialysate port inserted (not shown in Fig. 2b).

The spring force to be overcome can be adjusted through the desired dimensioning of a constriction 36. Since both the base body 2 and the shift element 3 are also preferably both made of plastic, the projections 12 and 12' as well as the opening areas 14 and 14' can be dimensioned easily and thus a material can be selected so that the catch operations can be performed without exerting excess force while nevertheless achieving a reliable locking which is discernible, in particular audible.

Regions 15 and 15' in which the wall thickness of the shift element 3 is reduced in the sense of a slope toward the opening 10 are connected to the opening areas 14 and 14'. The function of this slope will be explained later on the basis of Fig. 3b.

Fig. 3a shows a section along the axis of symmetry of the connector 1 in the direction of displacement of the shift element 3, whereby the shift element 3 is in the first position. In this view, the first sleeve 4 as well as the second sleeve 5 of the base body 2 can also be seen. The first sleeve 4 has a lumen 8 passing through it, and the second sleeve 5 has a lumen 16 with a smaller diameter passing through it. There is a constriction 17 between the two lumens. The one-piece base body is connected by a ring-like wall 7 in the connecting area between the first and second sleeves. The recesses 6 and 6' to accommodate the shift element 3 are discernible at the first end 4 of the base body 2. Since the shift element 3 is in the first position, the lumen 8 is not impaired in being opened by the shift element.

The shift element 3 is designed to be flexible enough to easily be installed in this position on the base body 2 by spreading the leg-like borders of the first opening 9. This is facilitated by a peripheral slope 34, which is also shown with dotted lines in Fig. 2a and Fig. 2b. In assembly of the shift element 3 on the base body 2 from the side of the second sleeve 5, the shift element 3 is pressed with the round opening 9 onto the base body 2 so that the sloping surface 34 strikes the rounded borders 35 of the base body 2 in the connecting area 7. This facilitates forward shifting of the shift element 3 until it engages in the recesses 6 and 6'. As an alternative, the slope 34 may also be provided on the other side of the shift element 3 when assembly is to take place from the side of the first sleeve 4.

With the shift element 3 in the first position, the inventive connector can be pushed onto to the dialysate port. The connector 1 is then locked by shifting the shift element 3 into the second position (Fig. 3b). The shift element 3 then engages behind the undercut 30, which is designed as a peripheral groove and is provided in the dialysate port 31. The dialysate port 31 is part of a dialysis machine housing 32.

The groove 30 is provided with a slope 33 inclined toward the end of the port. The regions 15 and 15' are designed to be form-fitting with this slope 33. This yields an axial force input which contributes toward securing the connector 1 on the port 31. The dialysate port 31 is pressed against the end face 7 of the base body 2, which at the same time serves as a stop for the port. In addition, peripheral projections 18 and 19, which serve to secure a sealing element 20 which may be designed as an O-ring, maybe be provided on the inside of the lumen 8. This gasket element 20 encloses the

outer end of the port 31, which has a suitably reduced outside diameter at this point to achieve a reliable seal of the connector 1 with respect to the port 31.

In the simplest case, the dialysate-carrying line - e.g., in the form of a length of tubing - may be placed on the second sleeve 5. Depending on the requirement, fixation with a wing nut may also be provided. Other connecting methods or non-releasable connections which are preassembled, e.g., by gluing or welding, may also be used. Those skilled in the art will be familiar with a wide variety of skillful embodiments.

The inventive connector permits a connection of a dialysate-carrying line to a conventional port of a hemodialysis machine which is easy and reliable to handle. Only a few individual parts are required, and those may be manufactured inexpensively from plastics by the injection molding technique. The connector may also be used with other ports whose connections can be inserted into the first end of the connector and which have an undercut that can be gripped with the help of the shift element for the purpose of locking. This is true in particular of all ports according to DIN 58352.